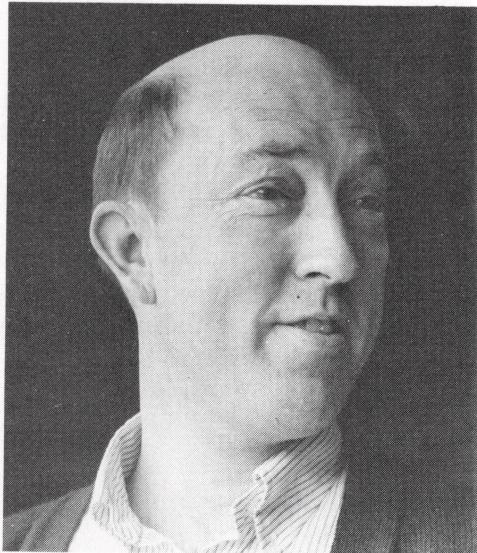


Morrow Designs
Thinker Toys™



Thinker Toystm



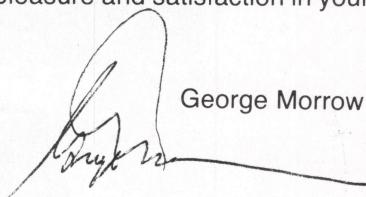
Seeing these products grouped together in the catalog is particularly exciting for me since I have been responsible for the design of most of them. Many are now second and third generation designs, dating from the time I became involved with microcomputers in 1974.

We at Thinker Toys are proud to have moved consistently toward design sophistication in all of our products. From my original design of Godbout ECONORAM™ 4K S-100 memory board to the latest Discus 2+2, we have depended on design innovation and efficiency to provide maximum function at a minimum of cost. We have had the privilege of being associated with the subcommittee which created the Proposed IEEE Standard for the S-100 bus. We will

continue to encourage both the refinement of, and adherence to these standardized disciplines.

Today, the range of choice and quality in every facet of S-100 hardware and software is truly phenomenal. It is an extraordinary achievement of the microcomputer industry to have attained so sophisticated a level of function in so few years... and for such little cost. It is an achievement shared by dozens of individuals, companies and suppliers... and especially by the thousands of system users whose enthusiasm and intellect have powered up our efforts.

We at Thinker Toys hope you will find as much pleasure and satisfaction in your S-100 system as we have had in creating it for you!



George Morrow

We proudly present...

SuperRam™ MEMORY MASTER 16K™

SuperRam™ MEMORY MASTER 24K

SuperRam 16K STATIC MEMORY

SuperRam 32K STATIC MEMORY

DISCUS I Full-Size, Single-Density Disk System

DISCUS 2D Full-Size, Double-Density Disk System

DISCUS 2+2 Full-Size, Double-Density, Double-Sided Disk System

THE WÜNDERBUSS™ with Noiseguard®

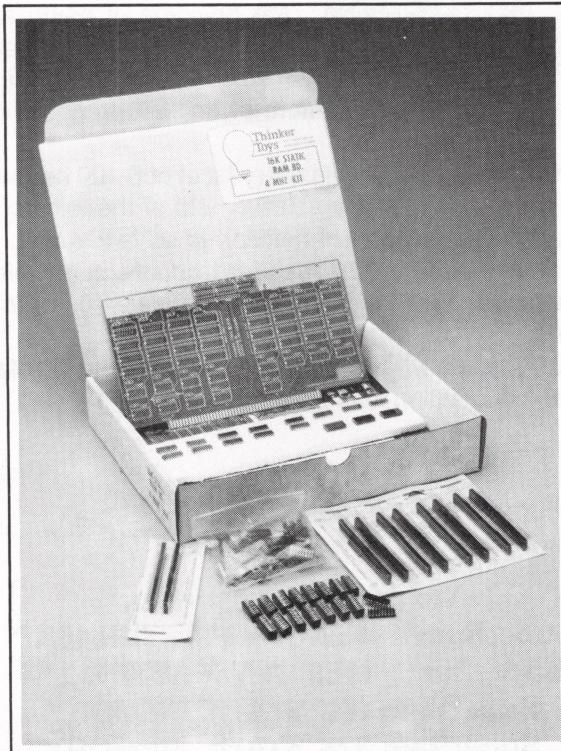
THE SWITCHBOARD™

Thinker Toystm

Construction

Cost-effectiveness in Morrow/Thinker Toys products is achieved by innovative and fully-optimized design... never by the use of substandard components. All boards and systems are available as assembled units and many as kits.

All integrated circuits in Morrow/Thinker Toys products are first quality parts from major manufacturers. All boards are built on the highest quality epoxy base with solder masks on both sides, plated-through holes and a parts legend. The layout of printed circuitry is not only drafted with technical precision but each is laid out to be aesthetically pleasing. Sockets are provided for every integrated circuit, making assembly and trouble-shooting easier.



Typical Kit

MEMORYTM MASTERTM 16K Static S-100 Memory with Bank Select Logic

The recently introduced Memory Master series is the top of our popular SuperRam static memory line.

The SuperRam MEMORY MASTER 16K offers four individually write-protectable 4K blocks... and a lot more!

The MEMORY MASTER 16K also provides the ability to utilize bank select logic, a method of expanding memory over 64K on the S-100 bus. An on-board switch-addressable I/O device & bit-select jumper block implement the bank select logic for the memory management software from Cromemco, Alpha-Micro, North Star and others.

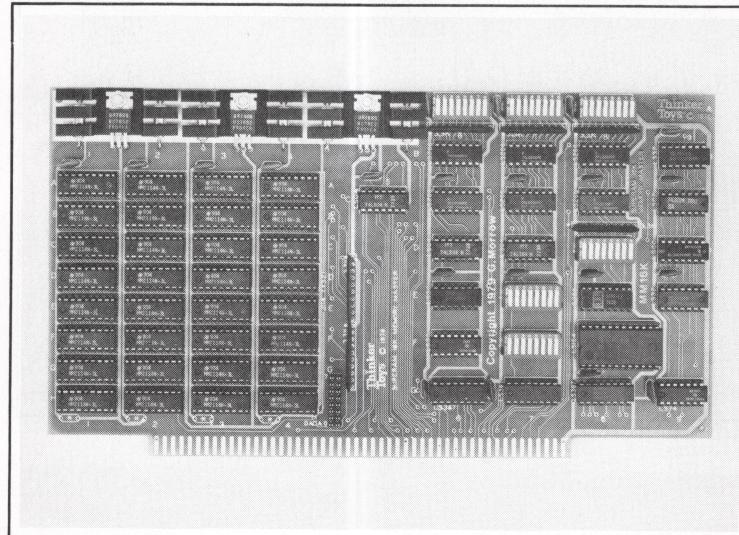
The MEMORY MASTER 16K also allows you

to disable any 1K sub-block via a DIP switch, opening efficient "memory windows" for VDMs, disc controllers, or other hardware which requires small amounts of memory.

This feature reclaims blocks of memory which cannot be addressed by other memory products — typically 1K to 3K per device — and reduces fragmentation of memory throughout the system.

When it comes to expanding an S-100 system using bank select logic, the SuperRam MEMORY MASTER 16K is the logical first move.

It is available in kit or assembled form and meets the Proposed IEEE Standard for the S-100 Bus. SuperRam MEMORY MASTER 16K will run with 2, 4, and 5 MHz systems.



Specifications:

- 16K STATIC random access memory board using type 2114-3L 1Kx4 memory and components.
- Four individual write-protectable 4K memory blocks, each addressable on any 4K boundary.
- Any of the sixteen 1K sub-blocks may be disabled, opening "windows" for other existing segments.
- Entire board can be enabled or disabled through a bit selected jumper of an addressable on-board I/O port.
- Switch selection to allow memory to be enabled or disabled at power on/reset.
- Switch selection to disable board when PHANTOM is active.
- Cycle time 320 ns. • Access time 320 ns.
- Power requirement 1.75 amps typical, 2.2 amps worst case.
- 5" x 10" epoxy glass circuit board with solder mask (both sides) and parts legend.
- S-100 compatible.

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SuperRamtm

MEMORY MASTER 24K

Static S-100 Memory with Bank Select Logic

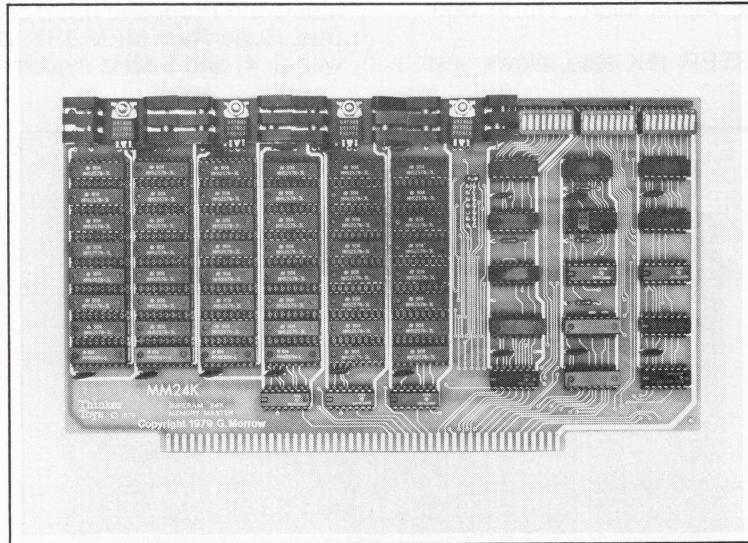
The SuperRam MEMORY MASTER 24K is ideal for building large S-100 systems with bank select logic capability.

The MEMORY MASTER 24K is configured as three 8K blocks, each individually addressable and write-protectable via a DIP switch.

The MEMORY MASTER 24K offers the ability to utilize bank select logic, the preferred method of expanding memory over 64K on the S-100 bus. There is an on-board switch-addressable I/O de-

vice and a bit-select jumper block to implement the bank select logic for the memory management software from Cromemco, AlphaMicro, North Star, etc.

The MEMORY MASTER 24K Static Memory is available in your choice of assembled or kit form. It is compatible with all 2 MHz 8080, 4 MHz Z-80 and 5 MHz 8085 systems and meets the Proposed IEEE S-100 Standard.



Specifications:

- 24K STATIC random access memory board using type 4044/5257-3L 4Kx1 memory components.
- Three individual 8K memory blocks, each addressable on any 8K boundary.
- Entire board enabled or disabled through a bit selected jumper of an addressable on-board I/O port.
- Switch selection to allow memory to be enabled or disabled at power on/reset.
- Switch selection to disable board when PHANTOM is active.
- Cycle time 320 ns. • Access time 320 ns.
- Power requirements 2.5 amps typical, 2.8 amps worst case.
- Single supply voltage 7-10 volts.
- 5" x 10" epoxy glass circuit board with solder mask (both sides) and parts legend.
- S-100 compatible.

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SuperRamTM

16K Static Memory

The SuperRam 16K Static Memory represents major savings in more ways than one.

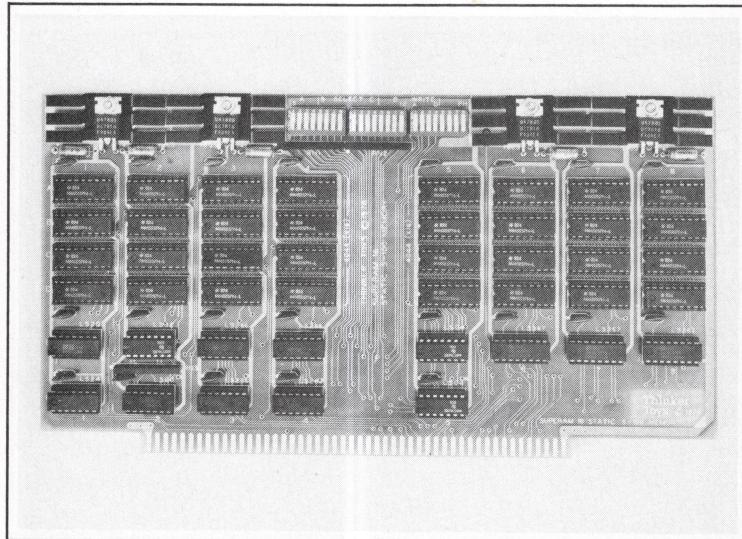
The design of the SuperRam 16K Static memory has been fully optimized to utilize a minimum of control logic. Therefore, the SuperRam 16K Static costs less and draws less power than other 16K designs. Instead of inefficiency, SuperRam 16K gives you extra features.

SuperRam is configured as four independent 4K blocks, each addressable and write-protect-

able via a DIP switch for flexibility. Plus, the SuperRam 16K lets you enable/disable the Phantom Line via a DIP switch for power-up sequencing.

If you're looking for the best buy in fast, low-power S-100 memory, the SuperRam 16K Static is the logical choice.

Compatible with all 2 MHz 8080, 4 MHz Z-80 and 5 MHz 8085 systems and meets the proposed IEEE S-100 standard. Available assembled and in kit form.



Specifications:

- 16K STATIC random access memory board using type 4044/5257-3L memory components.
- Four individual write-protectable 4K memory blocks, each addressable on any 4K boundary.
- Switch selection to disable board when PHANTOM is active.
- Cycle time 320 ns. • Access time 320 ns.

Thinker Toys™

SuperRam™

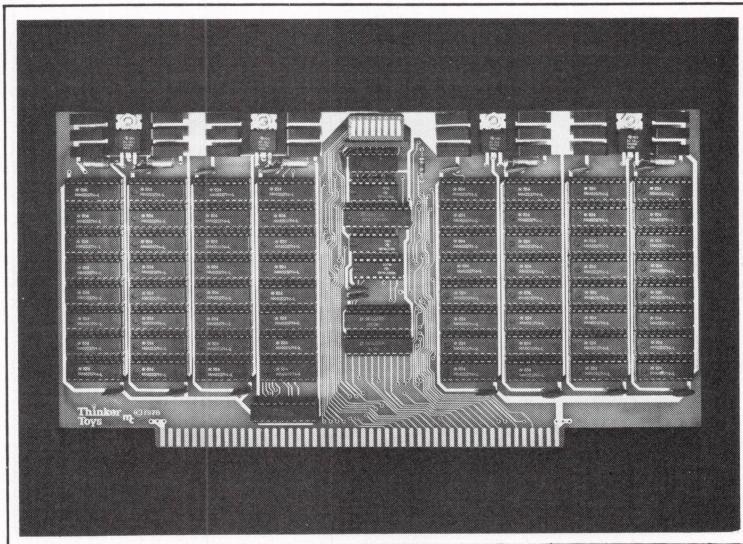
32K Static Memory

The SuperRam 32K is the ideal solution for systems requiring a maximum of memory capability in a minimum of space.

The SuperRam 32K provides two 16K blocks, each addressable and write-protectable via a DIP switch. For power-up sequencing, the PHANTOM line can be enabled or disabled by means of a DIP switch. The SuperRam 32K static is built with

fast, exceptionally low powered static memory parts, reducing its power requirement to just 2.7 amps.

The SuperRam 32K is available assembled tested or in kit form. It meets the Proposed IEEE Standard for S-100 bus and is compatible with 2 MHz 8080, 4 MHz Z-80 and 5 MHz 8085 systems.



Specifications:

- 32K STATIC random access memory board using type 4044/5257-3L memory components.
- Two individual write-protectable 16K memory blocks, each addressable on any 16K boundary.
- Switch selection to disable a board when PHANTOM is active.
- Cycle time 320 ns. • Access time 320 ns.
- Power requirements 2.7 amps typical, 3.2 amps worst case.
- Single supply voltage 7-10 volts.
- 5" x 10" epoxy glass circuit board with solder mask (both sides) and parts legends.
- S-100 compatible.

DISCUS 1

Full-Size, Single-Density Disk Memory System

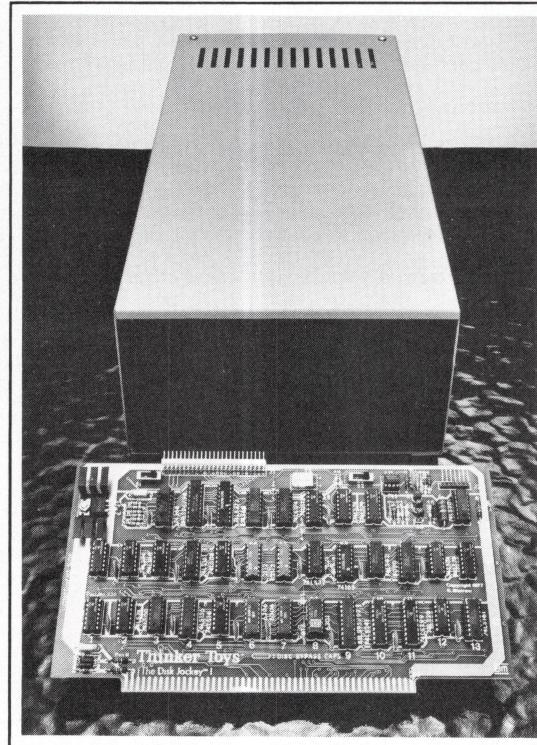
The DISCUS 1 full-size, single-density disk memory system offers the opportunity to move your S-100 system into the large storage capability and high speed access of an 8" drive.

DISCUS 1 gives you 250,000 bytes per diskette with five times the access speed of a mini-floppy. Yet, the cost is only slightly higher.

DISCUS 1 full-size, single-density disk system is complete in every way—complete with all hardware, all software and completely assembled and tested.

The full-size disk drive used in the system has been selected for its field proven reliability. The drive is factory mounted in an attractive all-metal beige cabinet, either single or dual drive, with its own independent power supply.

The Disk Jockey™ 1 controller comes equipped with on-board ROM with all necessary disk functions: BOOT, HOME, SEEK, READ DATA, WRITE DATA. A 256 byte RAM cache buffer. The controller also features an on-board serial I/O port to eliminate the need of I/O patches to the operating system. DISCUS 1 can be brought up in a matter of minutes.



Specifications:

Data Specifications and Formats

- 250,000 byte capacity per standard 8" floppy diskette.
- Soft-sectorized IBM-compatible format: 77 tracks/26 sectors per track/128 bytes per sector.
- Includes Disk/ATE™ disk operating system with integral monitor, assembler and text editor & BASIC-V advanced virtual disk BASIC capable of addressing up to 1 megabyte.
- Software customized for SOL and Exidy available.
- Patches for CP/M* included.
- Optional CP/M* Microsoft BASIC, and FORTRAN available.

Disk Jockey 1 Controller Specifications

- S-100 compatible.
- Plug compatible with Shugart SA800/850 disk drives.
- Capable of handling up to four disk drives.
- Contains on-board serial I/O port and 256 byte cache buffer; on-board ROM with bootstrap, home, seek, read data, write data, serial input and serial output functions.
- All software pre-interfaced to the controller's on-board I/O port for immediate start-up.
- Single voltage +7-10 volts @ 700 ma.

DISCUS/2D™ Double Density Disk System

Why not go all the way to the professional/industrial standard of 600K byte/side disk memory with your S-100 system? The new DISCUS/2D™ full-size, double-density floppy disk system is actually less expensive than many mini-floppy systems.

And Thinker Toys™ hasn't just made full-size, double-density disk memory affordable... we've made it more functional.

Thinker Toys™ has developed BASIC-V™ a virtual disk BASIC that lets you address all 600K bytes (expandable to 1 megabyte) as if it were main memory. The data format is soft-sectored and compatible with IBM's new System 34. And DISCUS/2D™ accepts both single-density and double-density disks for complete flexibility in data storage.

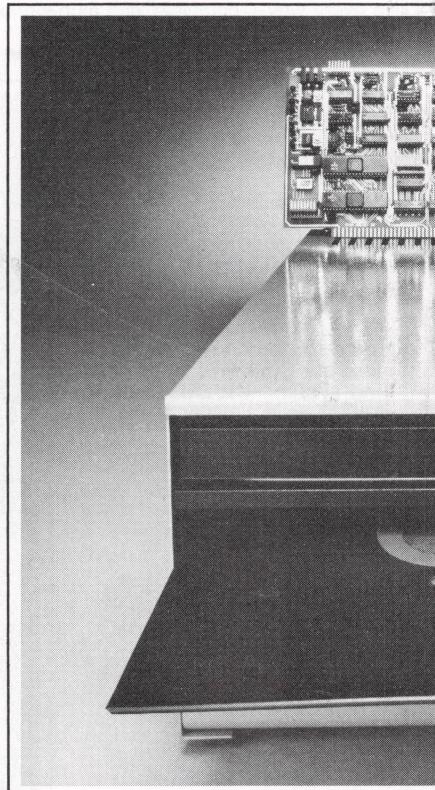
And DISCUS/2D™ is even more attractive because it's priced and delivered as a truly complete system. It's complete with all hardware. It's complete with all necessary software. And it's completely assembled, tested and warranted.

The disk selected for its field-proven reliability is fully mounted in an attractive all-metal cabinet with a built-in power supply. The controller utilizes the proven technology of phase lock loop data separation and write precompensation logic to enhance data integrity. Other controller features include power-up jump circuitry, on-board 1K RAM buffer, 1K of on-board ROM with built-in disk functions, a hardware UART, and switch programmable baud-rate generator to make I/O interfacing a snap.

A detachable fused AC line cord, the drive-controller cable, and a serial I/O connector set are also included.

The DISCUS/2D™ system also includes all necessary software. In addition to our exclusive BASIC-V™ virtual disk BASIC, you get DISK-ATE™ software—an extremely convenient integration of a disk operating system, a system monitor, a text editor, and an assembler. A wide selection of other popular disk software is also available as extra-cost options... all pre-interfaced to your controller's on-board UART for instant system start-up.

Check the current DISCUS/2D™ price. You'll be surprised how little it costs to go all the way to full-size, double-density.



Specifications:

- Plug compatible with Shugart, Remex and Siemens single- or double- sided drives.
- Double/single-density capability utilizing MFM and FM data formats.
- Western Digital 1791 LSI floppy disk controller chip.
- Uses 2K of S-100 address space:
 - 1K PROM with built-in disk drive and I/O utility subroutines incorporating memory mapped I/O.
 - 1K 2114-3L 300 ns access time RAM for disk data buffering and general purpose use.
- Starting address of memory space is 340:000 (E000 hex) for compatibility with other popular ROM based systems.
- Phase-locked data separator and crystal controlled disk data write precompensation capability to insure the highest standards of data integrity in double density mode.
- Compatible with all 2 MHz and 4 MHz systems which conform with the proposed IEEE standard for the S-100 bus.
- 1602 UART with crystal-controlled baud-rate generator.
- Sixteen switch selectable baud rates from 50 to 19,200 bits/second.
- TTY current loop and industry standard RS232C serial interface.
- Power-on jump circuitry for automatic bootstrap loading from the disk drive.
- Power supply requirements: +8v @ 1200 ma; +16 v @ 150 ma; -16 v @ 70 ma.
- ROM utility subroutines:

Bootstrap load	Seek	Disk write
Terminal input	Set sector	Select drive
Terminal output	Set DMA address	Terminal panic detect
Home	Disk read	Terminal status

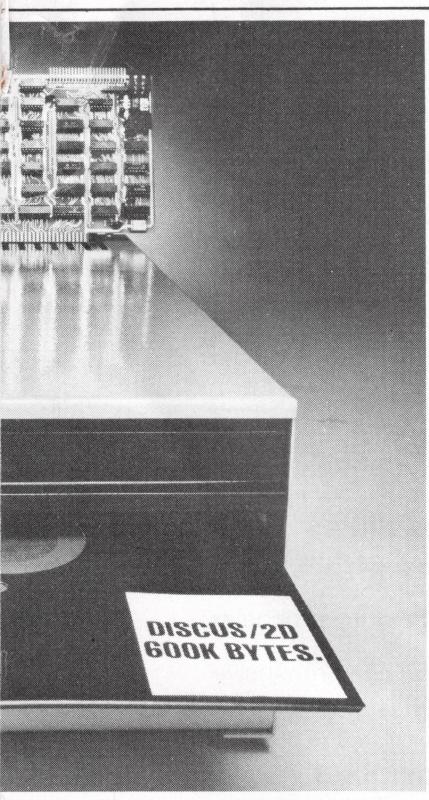
DMA status
Disk status
Disk error
Switch density

DISCUS™ 2+2 Quad-Density Disk System

1.2 million bytes of data on a SINGLE disk drive—that's the DISCUS™ 2+2 quad-density disk system. It has the equivalent capacity of a dual-drive DISCUS/2D™ system but at half the cost of an "add on" drive!

Quad-density is achieved by use of the *double-sided* drive which records information on *both* sides of the diskette instead of just one. Several years ago, the floppy disk manufacturers announced the development of the double-headed drives... and now they're being delivered in production quantities. And, the Disk Jockey 2D controller was designed so that it could be used with these double-sided drives as well as the single-sided. Moreover, the firmware on the controller has been tailored to take advantage of the increased stepping rate of the double-sided drives so that the average seek time for the DISCUS™ 2+2 is half that of the dual-density system. The standard software included with the disk systems has been customized so that it will work with quad-density as easily as it does with other configurations.

And, it's a snap to mix and match the double-density and quad-density drives. The Disk Jockey/2D controller is capable of distinguishing between the two. The controller can also support up to *four* drives in any combination which means on-line storage capability ranging from 500,000 to five million bytes!



Specifications: DATA SPECIFICATIONS AND FORMATS

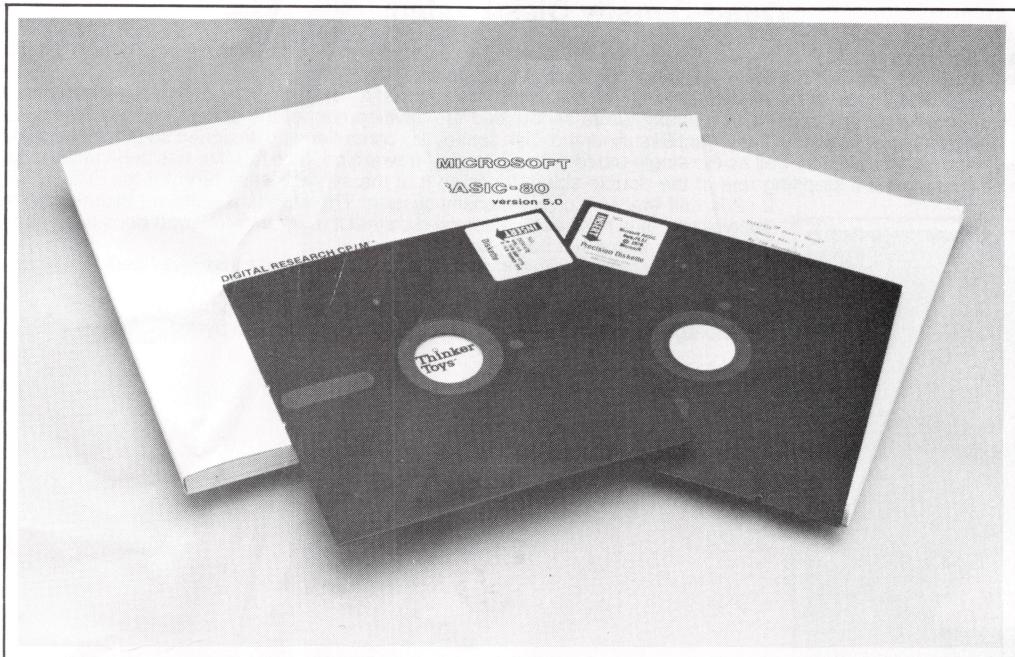
- Industry standard IBM soft sectored data format:
 - Frequency modulated (FM) single density data.
 - Modified frequency modulated (MFM) double-density format.
- Format software included supporting four IBM compatible sector formats:
 - 26 sectors per track per side, 128 bytes per sector
 - single-density, single-sided — 256,256 byte capacity
 - single-density, double-sided — 512,512 byte capacity

- 26 sectors per track per side, 256 bytes per sector
 - double-density, single-sided — 509,184 byte capacity
 - double-density, double-sided — 1,018,368 byte capacity
- 15 sectors per track per side, 512 bytes per sector
 - double-density, single-sided — 587,008 byte capacity
 - double-density, double-sided — 1,174,016 byte capacity
- 8 sectors per track per side, 1024 bytes per sector
 - double-density, single-sided — 625,920 byte capacity
 - double-density, double-sided — 1,251,840 byte capacity
- CP/M* version 1.4 available in single-density format customized for the Disk Jockey 2D controller.
- CP/M* version 2.0 available in double-density format customized for either DISCUS/2D or DISCUS 2+2 systems.
- Disk/ATE™ available in single-density format or double-density format; 1024 byte sector double-density.
- Customized software available for SOL.

*Now available in new, soft beige color!

19.2K 1%

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DISK SOFTWARE

Designed to make the most of full-size disk capabilities

Every DISCUS™ single- and single/double-density disk system comes with a library of high-performance, fully-interfaced software.

In addition, Thinker Toys™ has acquired vendor rights for many of the most popular software packages available for disk systems.

All software from Thinker Toys™ is delivered on full-size diskette with comprehensive documentation.

DISK-ATE™

An integrated disk operating system/editor/assembler

The primary software for DISCUS™ disk memory systems is DISK-ATE™, an extremely versatile software package that integrates a disk operating system, a file management system, a system debugger, a text editor, a batch processor and a fully symbolic assembler.

Each of these functions is highly-developed in its own right. The text editor is both interactive and programmable. The assembler has conditional psuedo-ops, radix commands, and accepts global symbols. And because all functions are fully integrated in DISK-ATE™ they are accessible to the operator at all times, and can also be accessed by external software.

DISK-ATE™ is pre-interfaced to utilize the I/O port on DISCUS™ system controllers for immediate start-up; DISK-ATE™ can then be utilized to modify its own interfacing and re-assemble its drivers to suit other I/O environments.

DISK-ATE™ is included in the base price of DISCUS I™, DISCUS/2D™ & DISCUS 2+2™ disk memory systems.

BASIC-V™ virtual disk BASIC

BASIC-V™ software, developed exclusively for Thinker Toys,™ opens the microcomputer to the most sophisticated professional applications.

BASIC/V™ utilizes the capacities of DISCUS™ single- and double-density disk systems in the most effective way: as "virtual" memory. Under BASIC/V™ the operator can address the entire disk system capacity as if it were main memory. BASIC-V™ can address up to 1 megabyte.

BASIC-V™ accommodates a wide variety of data types, including string-oriented arrays with an unlimited number of dimensions. Output can be formatted. And there's a host of other features.

BASIC-V™ is included in the base price of DISCUS™ single- and double-density disk memory systems.

CP/M* disk memory utility software

CP/M* is the most widely-used operating system for floppy disk memory systems, due in part to the wide variety of software tailored to interface with it.

Thinker Toys™ has therefore arranged to make CP/M* available to DISCUS™ system buyers.

Single- and double-density versions are now available. See current pricelist for price and ordering information.

Patches for single-density CP/M* are provided with DISCUS™ systems for those who have previously purchased CP/M* from Digital Research.

MicroSoft Extended Disk BASIC

Thinker Toys™ has arranged to make MicroSoft Extended Disk BASIC available as an extra-cost option to DISCUS™ system buyers who prefer this excellent and popular BASIC. MicroSoft Extended Disk BASIC runs under CP/M.*

Check the current Thinker Toys™ pricelist for price and delivery information.

MicroSoft FORTRAN

For DISCUS™ system buyers with heavy number-processing requirements, a properly interfaced version of MicroSoft FORTRAN is available as an extra-cost option. MicroSoft FORTRAN runs under CP/M.*



THE WÜNDERBUSS with Noiseguard® High-performance S-100 bussboards

The first step in establishing reliability in a microcomputer system is obtaining basic signal quality.

That's why George Morrow designed The Wunderbuss™ with Noiseguard®, the first S-100 bussboard with both full shielding and active termination on all busslines.

Each bussline is isolated from noise and crosstalk by an interlaced system of ground-lines and cross-coupled ground planes. This provides a cocoon of "quiet space" for each signal. Each line terminates at an active circuit which absorbs signal reflections.

The combination of signal isolation and reflection damping produces signals that are "textbook clean" with dramatically improved system reliability.

The Wunderbuss™ with Noiseguard® also provides on-board power supplies for small peripherals: +5V, +12V and -12V. All power sources are equipped with "fast-on" connectors to make hookup a snap instead of a soldering job.

The Wunderbuss™ is electrically and mechanically compatible with all S-100 systems meeting the Proposed IEEE Standard for S-100.

20-slot, 12-slot and 8-slot models are available in both kit and assembled forms.

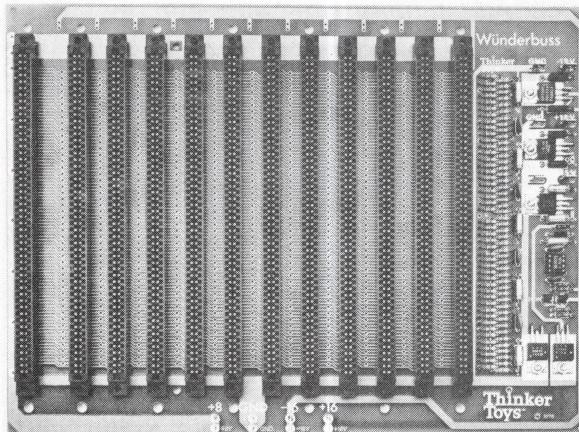
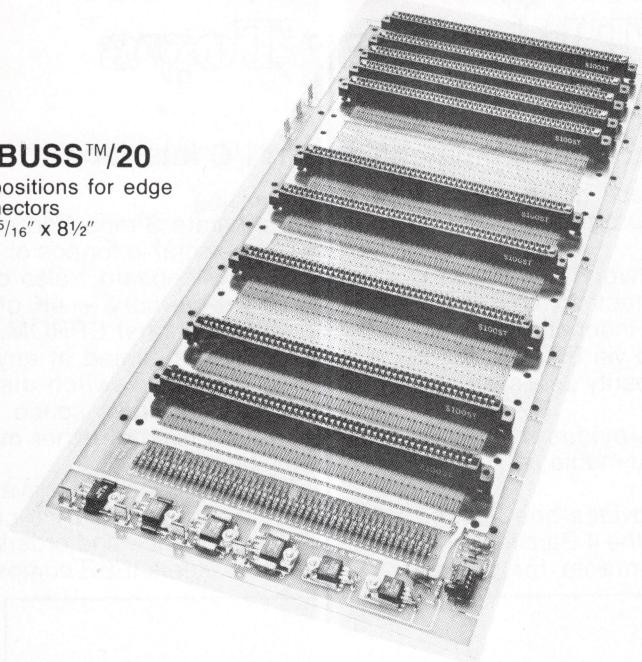
Specifications:

- Edge Connectors: S-100 type, .125" spacing on 3/4" centers.
- Shielding: Every signal fully shielded by both interconnected ground lines, 2nd cross-coupled ground planes.
- Termination: Active termination of each line. Termination network includes LM 201 op amp and 2 PNP/NPN pairs for buffering to 2.4 volts at 180 ohms.
- Mounting: Holes at each edge connector position, plus auxiliary holes to fit IMSAI cabinet.
- Power Connectors: "Fast on" connectors at all 10 positions.
- Power Required: 7 to 10 volts; 14 to 20 volts; -14 to -20 volts.
- Peripheral Power Outputs: 5 volts at 1 amp; 12 volts at 500ma; -12 volts at 500ma.
- Circuit Board: Double-sided glass epoxy with plated through holes. Solder mask on both sides and parts legend.

WÜNDERBUSS™/20

Capacity: 20 positions for edge connectors

Dimensions: 17⁵/₁₆" x 8¹/₂"



WÜNDERBUSS™/12

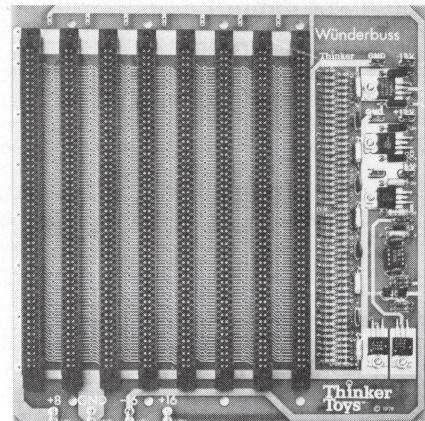
Capacity: 12 positions for edge connectors

Dimensions: 11¹/₂" x 8¹/₂"

WÜNDERBUSS™/8

Capacity: 8 positions for edge connectors

Dimensions: 8¹/₄" x 8¹/₂"



Switch-programmable 8-port I/O Interface

The Switchboard™ I/O Interface gives you total I/O flexibility with 8 switch-programmable I/O ports.

The Switchboard™ has two RS232C/TTY serial ports, each switch-selectable for baud-rates from 50 to 19,200. Each fully independent serial port can also be programmed via DIP switch for stop bit length, parity enable, parity odd/even, and 7- or 8-bit wordlength.

The Switchboard™ also provides 4 parallel I/O ports, each switch-programmable as input or latched output.

A separate Status Port provides one latched attention status bit for each of the 4 Parallel Ports, individually switch-programmable for pos or

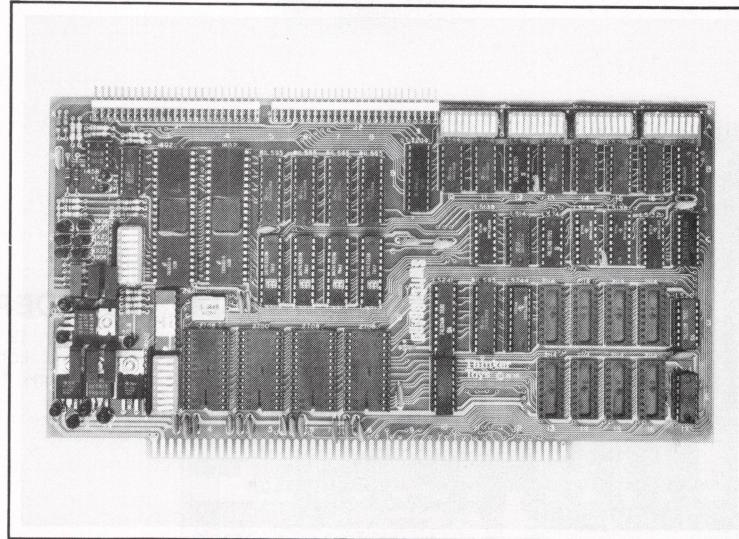
neg pulsing.

A separate Strobe Port provides 8 lines, each switch-selectable for pos or neg strobing.

The Switchboard™ also offers two options for on-board memory — 4K of optional RAM and/or 4K of optional EPROM. Either memory option may be located at any 4K boundary via a DIP switch. Or switch-disabled to disappear from CPU address space. Another DIP switch allows disabling of either memory via the Phantom Line.

The Switchboard™ is available in both kit and assembled form. See the current Thinker Toys™ price list for price and ordering information.

Notes: Meets IEEE/compatible with 2,4,5 MHz.



Specifications:

Eight I/O Ports: I/O ports DIP switch selectable for location on any boundary of the I/O address space divisible by 8.

Two RS232C/TTY current loop serial ports: • fully independent serial ports • stop bit length selection • parity enable selection • parity even/parity odd selection • seven or eight bit word length selection • sixteen selectable baud rates from 50 to 19.2K.

One serial status port: • serial port #1—least significant 4 bits • serial port #2—most significant 4 bits • receiver buffer full status • transmitter buffer empty status • parity error status • over-run error status.

Four Independent Parallel I/O Ports: Thirty-two lines of I/O available. Each group of eight lines DIP switch selected as input or *latched* output. Attention status bit for each group of eight I/O lines.

Separate STATUS Port: One latched attention status bit for each parallel I/O port. Attention bit selected by DIP switch to latch on positive or negative pulse or level. Status bit reset automatically by input reference of associated port.

Separate STROBE Port: Eight independent strobe lines. Each line DIP switch selectable to be positive or negative strobe.

Two 50-pin Flat Cable Connectors: One serial port, two parallel ports, two attention status bits, and four strobe lines per 50-pin connector.

Power Requirements: 8 volts @ 1 amp; 16 volts @ 150 ma; -16 volts @ 100 ma.

4K RAM Option: Eight 2114-3L 1Kx4 read/write static memory chips. Addressable by DIP switch on any 4K boundary. May be completely disabled via DIP switch so as to disappear from the address space of the CPU.

4K EPROM Option: Four 2708 1Kx8 erasable programmable read only memory. Addressable by DIP switch on any 4K boundary. May be completely disabled via DIP switch so as to disappear from the address space of the CPU.

Phantom Disable: DIP switch selection to allow the PHANTOM line to disable RAM and EPROM memory resident on the board.

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WARRANTY INFORMATION

All assembled boards are tested and burned in prior to shipment and warranted for six months from date of purchase.

Warranty protection on Shugart disk drives is for forty-five days at no charge and up to one year at a flat fee of \$55.00.

There is a ninety-day warranty on items purchased in kit form. It is limited to replacement of faulty components.

Proof of purchase showing date purchased is required for warranty service.

Warranty is void if the unit has been subject to misuse, abuse, improper assembly or to unauthorized modifications or unintended usage.

Morrow/Thinker Toys assumes no responsibility for consequential damage.

Please note: Specifications, prices and terms are subject to change without notice.

Morrow Designs Inc./Thinker Toys, 5221 Central Ave., Richmond, California 94804, 415/524-2101

TECH - 524 -
2104 15

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Phoenix, AZ 85016
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Berkeley, CA 94710
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*Computerland of El Cerrito
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El Cerrito, CA 94510
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